

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.: 10/566,048 Confirmation No.: 9408
Applicant: Shihe Xu
Filed: 01/26/2006
TC/A.U.: 1794
Examiner: Wilson, Michael H.
Docket No.: DC5161 PCT1
Customer No.: 00137
Date: 24 June 2009
For: Carbazolyl-Functional Polysiloxane Resins, Silicone Composition, and
Organic Light-Emitting Diode

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office Action dated 03/02/09, Applicant respectfully requests review of the final rejection in the above-identified application for the reasons stated on the attached sheets. Enclosed herewith is a Notice of Appeal.

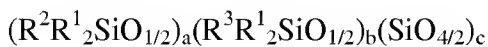
Reasons for Request

Claims 1-4 of the present invention are drawn to a carbazolyl-functional polysiloxane resin, claim 5 is drawn to a silicone composition containing a carbazolyl-functional polysiloxane resin, and claims 6-8 are drawn to an organic light-emitting diode (OLED) containing a carbazolyl-functional polysiloxane. Importantly, the OLED of the present invention exhibits good resistance to abrasion, organic solvents, moisture, and oxygen. Furthermore, the OLED exhibits high quantum efficiency and photostability.

Claims 1 to 5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Morita (U.S. Patent No. 5,310,843) in view of Kitano et al. (U.S. Patent No. 6,544,670), Tang et al. (U.S. Patent No. 4,769,292), and Mimura et al. (Photoelectric Properties of Organic Polysilane Containing Carbazolyl Side Groups, Applied Physics Letters, 2 October 2000, 77, No. 14, 2198-2200). Regarding claims 1-5 Examiner states:

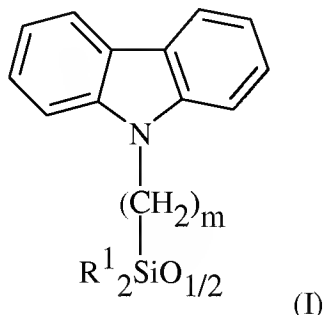
Morita discloses a functional polysiloxane resin comprising units of instant formulae (II) (unit b, abstract; example 7, column 7), and (III) (unit c, abstract, example 7, column 7). The unit of instant formula (II) is disclosed in general in column 2, lines 24-31, and specifically in column 7, line 65 with a R^1 of methyl, an R^2 of ethylene, Z of methoxy, and an n of 0. The reference also discloses a silicone composition comprising a functional polysiloxane resin, a condensation catalyst (column 3, line 54 to column 4, line 2), and an organic solvent (column 5, line 63 to column 6, line 1). The reference also discloses the ratio of "monofunctional" units to "tetrafunctional" units as 0.2:1 to 4:1 (column 2, line 32). However, the reference does not explicitly disclose a unit of instant formula (I).

Morita discloses an MQ organopolysiloxane having an epoxy-containing organic group, wherein said organopolysiloxane is represented by the following general formula:



R^1 is a non-alkenyl monovalent hydrocarbon group, each R^2 is independently selected from a hydrogen atom or a non-alkenyl monovalent hydrocarbon group, each R^3 is independently selected from an epoxy-containing organic group or an alkoxysilylalkyl group, a is 0 or a positive number, b and c are positive numbers, a/c has a value of 0 to 4, b/c has a value of 0.05 to 4, and

(a+b)/c has a value of 0.2 to 4 (col. 2, lines 14-32). Morita *does not* teach Applicant's siloxane units having the formula (I):



Morita also does not teach Applicant's silicone composition comprising a carbazolyl-functional polysiloxane resin, a *condensation catalyst*, and an organic solvent. Instead, Morita teaches a method for producing an organopolysiloxane having an epoxy-containing organic group comprising reacting in the presence of (A) a *hydrosilylation-reaction catalyst*, with (B) an SiH-containing organopolysiloxane, (C) an aliphatically unsaturated epoxy-containing organic compound, and optionally (D) an alkoxysilylalkene (col. 2, lines 33-51, emphasis added). The hydrosilylation catalyst of Morita's reaction mixture is a catalyst for the addition reaction between the silicon-bonded hydrogens in component (B) and the aliphatically unsaturated bonds in components (C) and (D) (col. 3, lines 54-58). The hydrosilylation-reaction catalyst is exemplified by platinum compounds, rhodium compounds, and palladium compounds (col. 3, lines 62-64). In contrast, the condensation catalyst of Applicant's silicone composition promotes condensation of silicon-bonded hydroxy (silanol) groups to form Si-O-Si linkages. Examples of condensation catalysts include, but are not limited to, tin(II) and tin(IV) compounds such as tin dilaurate, tin dioctoate, and tetrabutyl tin; and titanium compounds such as titanium tetrabutoxide (see para. [0064]). Hydrosilylation catalysts are not the same as or interchangeable with condensation catalysts.

To remedy the deficiency in Morita regarding Applicant's siloxane units having the formula (I), Examiner proposes combining the teaching of Kitano et al. as modified by Mimura et al. and Tang et al. with the teaching of Morita. In particular, Examiner states:

Kitano et al. teach a siloxane polymer for use as a hole transporting polymer in an electroluminescent device (abstract). The reference teaches units similar to instant formula (1) and unit a of Morita (abstract) as hole transporting units (last structure in column 17, line 25; column 16, line 39 to column 17, line 36) where B' is an alkyl and A' is an aromatic amine.

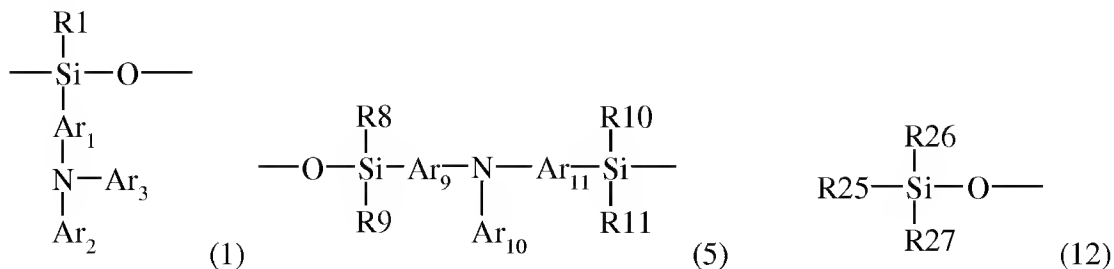
Mimura et al. teach organic polysilanes with carbazolyl side groups (abstract). The reference teaches polysilanes with propylcarbazolyl side chains have high hole mobility (are hole transporting) (page 2198, column 2, lines 2-7).

Tang et al. teach tertiary amine compounds as hole transporting compounds useful for electroluminescent devices (column 36, lines 29-37). The reference further teaches N-carbazoles as equivalent to and interchangeable with tertiary arylamines (column 37, lines 62-68). In view of Tang et al.'s recognition that tertiary arylamines and N-carbazoles are equivalent and interchangeable, it would have been obvious to one of ordinary skill in the art to substitute tertiary arylamine of Kitano et al.'s siloxane unit with N-carbazoles and thereby arrive at the present invention.

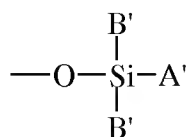
Further, it would be obvious to one of ordinary skill in the art at the time of the invention to bind the N-carbazole to the Si atom through an alkyl as demonstrated by Mimura et al. (Figure 1). One of ordinary skill in the art would be motivated by the teachings of Mimura et al. that use of an alkyl linkage is suitable and results in a polymer with high hole mobility.

It would be obvious to one of ordinary skill in the art at the time of the invention to add the carbazolyl-siloxane unit of modified Kitano et al. (Kitano combined with Mimura and Tang et al.) to the polymer of Morita. One of ordinary skill in the art would reasonably expect such a combination to [be] suitable given both references teach polysiloxane compositions. One of ordinary skill in the art would be motivated by a desire to produce a hole transporting polysiloxane.

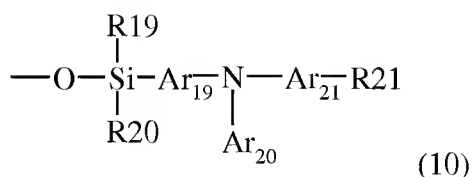
Kitano et al. teach a first hole-transporting polymer comprising a repeating structural unit represented by the general formula (1), a second hole transporting polymer containing a repeating structural unit represented by the general formula (5), and a third hole-transport polymer, the second hole transporting polymer which contains at least one group represented by the general formula 12:



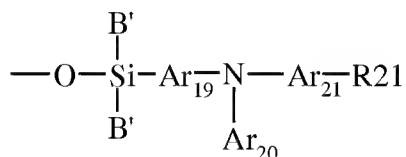
Kitano et al. teach the second hole transporting polymer or the third hole transporting polymer may include structural units represented by formula (s1) and (s2) (col. 16, line 39 to col. 17, line 36). The last structure in col. 17, line 25 has the formula:



where A' represents an aromatic amine group in the repeating structural unit represented by the general formula (10):



Substituting the aromatic amine group in the structural unit having the formula (10) for A' in the first formula gives a unit having the formula:

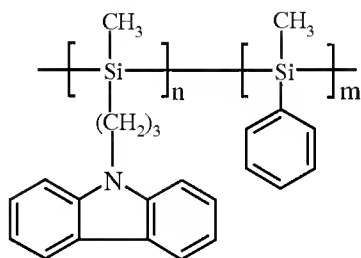


The preceding siloxane unit taught by Kitano et al. neither contains a carbazolyl group nor an alkylene group having 3 to 10 carbon atoms linking the nitrogen atom of the carbazolyl group to the silicon atom of the siloxane unit.

To remedy the deficiency in Kitano et al. regarding Applicant's carbazolyl group, Examiner proposes modifying the teaching of Kitano et al. with the teaching of Tang et al. The latter teach that aromatic tertiary amines and N-substituted carbazole compounds are useful as hole-transporting compounds in the electroluminescent device of their invention (col. 37, lines 65-68). However, Tang et al. do not teach or suggest that *substituent groups* derived from N-substituted carbazole compounds (i.e., carbazolyl groups) are equivalent and interchangeable with the tertiary amine *substituent groups* in the siloxane polymer of Kitano et al. for the purpose of hole transport. The hole transport properties of a carbazolyl-substituted siloxane are not due merely to

the carbazolyl substituent independent of its macromolecular environment. Rather, the hole transport properties of a carbazolyl-substituted siloxane are influenced by many factors, including polymer structure, conformation, composition, and molecular weight. The hole transport properties of a carbazolyl-substituted siloxane can not be reasonably inferred from the hole transport properties of an isolated N-substituted carbazole compound. Therefore, it would not have been obvious to one of ordinary skill to substitute the tertiary arylamine group in the siloxane unit taught by Kitano et al. with a carbazolyl substituent group derived from the carbazole compounds taught by Tang et al.

To remedy the deficiency in Kitano et al. as modified by Tang et al. regarding Applicant's alkylene group between the silicon and nitrogen atoms in the siloxane units having the formula (I), Examiner further proposes modifying the already modified teaching of Kitano et al. with the teaching of Mimura et al. The latter teach that the hole drift mobilities of N-carbazolyl-substituted silane copolymers having the formula:



are essentially the same as those of polymethylphenylsilane (Abstract and page 2200, column 1, lines 24-28). Notably, Mimura et al. are concerned only with organic polysilanes having a linear -Si-Si- backbone. The authors do not teach or suggest that replacing an arylene linkage in a carbazolyl-substituted siloxane unit (Kitano et al. as modified by Tang et al.) would result in a siloxane unit useful for producing a *polysiloxane* having high hole drift mobility.

The hole mobilities of the polysilanes of Mimura et al. are not determined merely by the carbazolylpropyl side groups, but rather by the interaction of the carbazolylpropyl side groups with the all-silicon backbone of the polymers. Indeed, Mimura et al. teach:

The results indicate that the photocreated charges on the carbazolyl groups transfer to the Si backbones and then transport through the Si backbones. We, therefore, regard the

CzMeSi/MePhSi copolymers as a class of polysilanes having both charge-generation sites and charge-transport sites. Such unique properties would be useful for photoelectric devices. (page 2200, col. 2, lines 32-34).

The fact that the specialized class of silane copolymers of Mimura et al. containing carbazolylpropyl side groups have hole drift mobilities comparable to polymethylphenylsilane does not mean the same relationship can reasonably be expected for polysiloxanes, particularly given that polysilanes are electrically conductive while polysiloxanes are electrically nonconductive. Therefore, one of ordinary skill in the art would not be motivated by the teachings of Mimura et al. to replace the divalent aromatic linking group in the siloxane unit taught by Kitano et al. as (improperly) modified by Tang et al., with the propylene group taught by Mimura et al. with the expectation of obtaining a siloxane unit useful for producing a polysiloxane having high hole drift mobility.

In view of the foregoing remarks, it would not be obvious to one of ordinary skill in the art at the time of the invention to (i) substitute the tertiary arylamine group in the siloxane unit taught by Kitano et al. with a carbazolyl substituent group derived from the carbazole compounds taught by Tang et al, (ii) replace the divalent aromatic linking group in the siloxane unit taught by Kitano et al. as modified by Tang et al. with the propylene group taught by Mimura et al., and (iii) add the siloxane unit resulting from modifications (i) and (ii) to the MQ organopolysiloxane taught by Morita.

Claims 6 to 8 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kitano et al. (U.S. Patent No. 6,544,670) in view of Morita (U.S. Patent No. 5,310,843), Tang et al. (U.S. Patent No. 4,769,292), and Mimura et al. (Photoelectric Properties of Organic Polysilane Containing Carbazolyl Side Groups, Applied Physics Letters, 2 October 2000, 77, No. 14, 2198-2200) for the reasons of record.

For the reasons stated above with regard to claims 1-5, the teachings of Tang et al. and Mimura et al. can not be properly combined with the teaching of Kitano et al. Therefore, it would not be obvious to one of ordinary skill in the art at the time of the invention to (i) substitute the tertiary arylamine group in the siloxane unit taught by Kitano et al. with a

carbazolyl substituent group derived from the carbazole compounds taught by Tang et al, (ii) replace the divalent aromatic linking group in the siloxane unit taught by Kitano et al. as modified by Tang et al. with the propylene group taught by Mimura et al., and (iii) add two of the siloxane units, $R^3R^1_2SiO_{1/2}$ and $SiO_{4/2}$, in the MQ organopolysiloxane taught by Morita to the second hole transport polymer or the third hole transport polymer in the organic electroluminescence device of Kitano et al.

In summary, Applicant submits that claims 1-8 in the instant application are both novel and nonobvious in view of the cited art. Absent sufficient grounds for establishing prima facie obviousness, the Office has improperly used Applicant's specification to search the art for individual fragments of Applicant's carbazolyl-functional polysiloxane resin, namely carbazolyl substituents, divalent linking groups, and siloxane units, and then attempted to reassemble the fragments into a macromolecule having the hole transport properties taught by the Applicant.

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Respectfully Submitted,

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